processes which we associate with the names of Husserl, Meinong, Bertrand Russell, and others. Although he makes good use of modern views about mathematics which have a certain connection with the latter researches, yet Prof. Ostwald, from lack of sympathy or for some other reason, appears to have assimilated very little from these typically modern doctrines about the fundamentals of his subject.

(2) In his familiarity with the present situation in logical criticism and philosophy, Graf Keyserling has a manifest advantage over his scientific compatriot. For this reason the six discourses which form his latest work offer most instructive as well as attractive reading even to those who cannot accept all his contentions. He sees with perfect clearness that the central question of natural philosophy is the question how conceptual thought is related to perceptual experience—in other words, how it is that we are able to theorise successfully. To understand the problem aright we must recognise that theories deal in the first place with entities—"universals," relations, numbers, &c.—which are distinct from the entities revealed to us in physical phenomena, and yet are really quite as external to our minds, quite as "objective" as the latter. Conversely, the phenomena commonly called external are known just as immediately and as truly as the objects of thought. It follows that the *a priori* laws which regulate our "inner" experience are entitled to be called "laws of nature" equally with the sequences determined *a posteriori* among "outer" experiences. A mind capable of taking in the universe at a glance would, in fact, see, not two worlds, but one world of reality, the elements of which are knit together by a univocal necessity.

This conception of the universe admitted, it is possible to understand that perpetual miracle—the power of "prospective and retrospective prophecy" wielded by the man of science. Consider one of the most notable instances: the power to predict and reconstruct phenomena by means of Newton's laws of motion. Since mathematical thought and the spatio-temporal series of external events run their courses under a single system of laws, it is always possible that in a given instance the mathematical realities and the empirical will, to use Graf Keyserling's word (p. 44), "coincide." Suppose this relation to hold good between Newton's laws and a group of mechanical events. Then whatever consequences follow by "logical" necessity from Newton's laws must be exhibited empirically; nature is bound, so to speak, to actualise this particular series of possibilities (p. 44). This account of the matter explains why induction does *not* (as the empiricists contend) involve essentially the contemplation of numerous instances. The essence of the process is (as Prof. Bosanquet and other writers have urged) the analysis of a given phenomenon with the view of discovering the "mathematical realities" which "coincide" with the empirical observations. If the details of the coincidence can be brought to light by the examination even of a single instance predictions based upon such an examination may have the highest certainty.

It is not possible to follow here the important consequences of Graf Keyserling's views. It must suffice to say that he develops them with great ability and in a very interesting way. He finds occasion to offer illuminating criticism of the pragmatists and of writers whose works are now the centre of much attention—for example, Hans Driesch and Henri Bergson. It is not extravagant to say that by his understanding of the problems and methods, both of philosophy and of science, his lucidity and his literary charm, he produces in no mean degree the same impression as the great Frenchman. The book is one which should find a welcome in an English translation.

T. P. NUNN.

TWO INTRODUCTIONS TO THE STUDY OF EVOLUTION.

(1) *The Doctrine of Evolution: its Basis and its Scope.* By Prof. H. E. Crampton. Pp. ix+311. (New York: The Columbia University Press, 1911.) Price 6*s*. 6*d*. net.

(2) *Einführung in die Deszendenztheorie.* Fünfunddreissig Vorträge. By Prof. Karl C. Schneider. Zweite Auflage. Pp. xii+386+3 Taf. (Jena: Gustav Fischer, 1911.) Price 9.50 marks.

(1) PROF. CRAMPTON has written a careful and interesting introduction to the study of evolution in the wide sense. It consists of eight lectures given in New York to "mature persons of cultivated minds, but who were on the whole quite unfamiliar with the technical facts of natural history," and for such an audience, which is certainly widespread, the book can be strongly recommended. But even those who know a good deal of natural history may read Prof. Crampton's lectures with great profit, for although they have not perhaps the keenness which marked the author's important contribution to the theory of natural selection (his study of *Philosamia cynthia*), they are characterised by scientific restraint, by careful workmanship, and by a wide outlook. The outstanding feature of the book is that half of it is devoted to the higher reaches of the evolution-process—to the ascent of man and the establishment of human societies.

After an introductory discourse on the living organism, Prof. Crampton sets forth the evidences of evolution from comparative anatomy, embryology, and palæontology. The fourth lecture is on "Evolution as a Natural Process," and here the author avoids controversy, contenting himself with a balanced statement of the various interpretations that have been offered. He then passes to the evolution of the human species and the human races, to mental evolution, and to social evolution. These three chapters are full of fresh illustrations of great interest. The book ends up with a courageous chapter on those "evolved products" which we call (1) ethics, (2) religion and theology, and (3) science and philosophy, the author's particular point being that here also evolution proves to be real. Not only are the higher elements in human life subject to analysis, classification, and formulation, but there are natural reasons in human evolution why there should be a developing ethics, religion, theology, science, and philosophy. The author ends up finely with a statement of the practical value of evolutionist conceptions:—

> "The doctrine of evolution enjoins us to learn the rules of the great game of life which we must play, as science reveals them to us. It is well to remember that a little knowledge is a dangerous thing, but because evolution is true always and everywhere, an understanding of its workings in any department of thought and life clears the vision of other realms of knowledge and action. . . . Evolution as a complete doctrine commands everyone to live a life of service as full as hereditary endowments and surrounding circumstances will permit."

After reading this admirable course of lectures, one general criticism arises in our mind—one, however, involving for its statement a longer discussion than is possible here and now. It appears to us that the author has not sufficiently analysed his "deeply grounded conviction that evolution has been continuous throughout." We wish to know more about this continuity—what it is that is continuous, and whether the continuity implies that there is an identity of causes throughout. The genetic method is certainly applicable, but do the same categories serve throughout? Is the truth with Spencer or with Bergson? It seems to us to be giving a false simplicity to the facts to conclude that "human social relations are biological relations," or that "identical biological laws, uniform in their operation everywhere in the organic world, have controlled the origin and establishment of even the most complex societies of men." It seems to us a matter for regret that a zoologist of Prof. Crampton's eminence should adopt, especially in a work of this sort, the mechanistic hypothesis without giving a statement of the other side. We are unaware that a mechanical description has been given of any complete vital operation, and if it were given we do not think that it would be what the biologist wants, for he cannot get away from the fact that the organism is a historical being.

We are only stating our opinion, but we think there is need for reconsidering, even in the light of other parts of the book, such a deliverance as this:—

> "Does science teach us, then, that the ultimate elements of human faculty are carbon-*ness* and hydrogen-*ness* and oxygen-*ness*, which in themselves are not mind, but which when they are combined, and when such chemical atoms exist in protoplasm, constitute mental powers? Plain common-sense answers in the affirmative."

And this:—

> "What can be the source of mentality, if it is not something brought in from the outer world along with the chemical substances which taken singly are devoid of mind? Scientific monism frankly replies that it is unable to find another origin."

Such a presentation of the old problem seems to us disappointing, especially when it comes from the country of William James and Josiah Royce.

(2) Prof. Schneider has prepared an enlarged edition of an admirable book which was reviewed in NATURE of January 10, 1907. It then consisted of six lectures introductory to the study of organic evolution, and was marked by clearness and freshness of exposition. It had also the crowning merit of being short, and was a pleasing contrast to a number of larger books of similar aim, which take a longer time to say less. In its new edition, however, it has surrendered the charm of brevity in the hope of securing other excellencies. It has become thirty-five lectures instead of six, and each lecture occupies about ten closely printed pages. What are the features of this practically new book, which, it may be noted, is not to be confused with the author's "Versuch einer Begründung der Deszendenztheorie"?

Perhaps the chief characteristic is the elaboration of the concept of "Anlagen" or primordia. The common way of looking at these as simply material structures will not stand criticism. In place of the view that morphogenetic differentiation may be interpreted in terms of the chemico-physical properties of the primordia, Schneider seeks to substitute a rehabilitation of the "idea-theory" of Plato and Goethe with which he combines the Aristotelian-Scholastic concept of potency, "elaborated in a modern exact fashion." Another feature of the book is a judicious eclecticism. For while there is much that is personal and original throughout, such as the author's theory of vitalism, his welcome, but all too short, discussion of the importance of periodicity, his criticism of the ordinary Darwinian position, and so on, there is a praiseworthy attempt to recognise a measure of validity in the suggestions of the various schools. He pleads for less purely argumentative criticism, for a deeper inquiry into fundamental principles, for a study of biological method, and for more determined effort to get away from preconceptions which influence even the experimenters. The Lamarckian, he says will not hear of mutations, and the Mutationist will not hear of modifications. The Darwinist rejects the psychical theory of adaptations, and the psycho-Lamarckian rejects determinants. The student of chromosomes does away with Anlagen, the "Orthogenetiker" with adaptations, the vitalist of Driesch's persuasion with vital energy, the Weismannist with the transmission of acquired characters, the Mechanist with all vitalistic principles, and so on. But all these views have factual relations, and there is a kernel of truth in each. They cannot be lumped together, but no view is as yet complete enough to dispense with the aid of others. Cooperation as well as criticism is needed among the evolutionists.

In his sketch of the evolutionism of the future, Prof. Schneider distinguishes primary or constitutive principles and secondary or auxiliary principles. The primary principles are three:—(1) The idea, which interpenetrates every organism and binds it into unity; (2) entelechy, which is "a kind of cohesion in the idea," holding the constellation of Anlagen in a specific order, a correlating, regulative, formative principle; and (3) vitality, a form of energy, like heat in the inorganic realm, which brings into material explicitness what is implicit in the idea, and includes two main factors, of assimilation, growth, and reproduction on one hand, of variation on the other.

The secondary or auxiliary principles, which represent a complication of the primary simplicity of idea, entelechy, and vitality, are of two kinds, ectogenous and endogenous. The ectogenous principles operate from without; they do not originate within the organism. They include the influence of environmental changes on assimilation and the like, and the influence of psychical impulses and needs relating to the external conditions of life. In both these ways a "somation" (corresponding to a somatic modification of most authors) may arise; it is an ectogenous change in contrast to an autonomous mutation. The endogenous secondary principles, which are also called entropic, include amphimixis and death.

THEORETICAL AND PRACTICAL PHYSICS.

(1) *A Text-book of the Principles of Physics.* By Dr. A. Daniell. New and revised edition. Pp. xxv+819. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 17*s.* net.

(2) *A Textbook of Physics.* By Prof. L. B. Spinney. Pp. xii+605. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 12*s.* net.

(3) *Principles of Physics: Designed for Use as a Text-book of General Physics.* By Prof. W. F. Magie. Pp. ix+570. (London: G. Bell and Sons, Ltd., 1911.) Price 7*s.* 6*d.* net.

(4) *Treatise on Practical Light.* By Dr. R. S. Clay. Pp. xv+519. (London: Macmillan and Co., Ltd., 1911.) Price 10*s.* 6*d.* net.

(1) IT is presumably the duty of a reviewer to try in reading a text-book to take up the point of view of the students for whom it is primarily designed. This attitude it is not at all easy in many cases to assume. But the third edition of Dr. Daniell's text-book scarcely admits of doubt in this respect. Regarded from a purely physical point of view, the book undoubtedly contains much useful information, notwithstanding the fact that it is presented in a peculiarly disjointed fashion. But to propose it as being suitable for medical students seems very misleading. Those who are experienced in teaching medical students, or, at any rate, the majority of them, know with what simplicity the principles of physics must be treated. The subject is one which the students themselves think is foreign to their medical course, and the complexity of detail with which this book abounds would surely make them adhere more strongly than ever to that opinion. But apart altogether from the question of suitability for any special class of students the book is in several other respects open to serious objections. In the first place, the unfortunate tendency in many recent physical text-books of quoting unproved numerous mathematical formulæ is especially prominent in this particular case. This is, in all probability, the main cause of the disjointed nature of the text already referred to. It must be admitted, of course, that such procedure is occasionally inevitable and even desirable, but when it becomes the rule and not the exception, it encourages students to regard physics as a series of formulæ to be committed to memory, and having no logical sequence.

Further, the mode of statement is often peculiarly involved, and sometimes inexact. The latter is illustrated by the statement that "a body free to fall in vacuo would be subject to a constant downward acceleration of about 981 *cm. per sec.*, or 32·2 *feet per sec*"—a statement quite in keeping with the unconvincing way in which the distinctions between velocity and acceleration have been previously treated. The following also is surely a rather extraordinary view to express:—"Kinetic friction is accordingly not a Force; it is a Resistance or Reaction."

The present edition has a supplementary chapter on radio-activity and kindred subjects added. Attention is directed to the chief points in recent work, but the numerical data in connection therewith have scarcely been brought up to date, the old value $3{\cdot}4 \times 10^{-10}$ E.S. being given, for instance, as the unit of electricity. The author has also adopted a uniform notation, and gives an index of symbols at the beginning of the book, but although, in this index, 10^9 is defined as being equal to 1,000,000,000, we frequently find very large numbers expressed in the uncontracted form. The arrangement of the mathematical treatment is also unfortunate from the point of view of facility in reading, being printed in small type, and from line to line, just like the ordinary text.

(2) Prof. Spinney's book will without doubt serve admirably the purpose for which it has been written. In nearly every respect it fulfils the necessary conditions. Being written for engineering and technical students entering upon a course of physics, it deals in a straightforward and logical way with the various sections into which the subject is usually divided. As is to be expected, particular prominence is given to mechanics, the principles of which are illustrated by familiar phenomena and practical contrivances. Although the mathematical treatment is intentionally limited, what is given is exact, and involves no blind learning of formulæ. Also, notwithstanding the professedly elementary character of the work, the author contrives to convey clearly the underlying principles of such subjects as surface tension, kinetic theory of gases, and polarisation of light in a way not often achieved. To each chapter is appended a series of numerical examples; the printing and arrangement of paragraphs and chapters are excellent, and the heavy type used for the more important statements is a distinct gain. The diagrams have evidently been carefully prepared, and are reproduced in a manner quite above the average. To all students desiring a thorough introduction to the science of physics, whether they be engineering students or not, this book can be unhesitatingly recommended.

(3) In some respects this book is unique. On several previous occasions have historical treatises on special parts of physics been published, but no general elementary text-book of physics based upon a historical outline has until now, we believe, appeared. The author's chief reason for adopting this mode of procedure—and it seems to be a good one—is that it directs attention to the lines upon which discovery has proceeded, and trains the mind of the reader in the processes which may lead to further discoveries. Whether this be the case or not, it is certain that the historical treatment makes the subject eminently readable, particularly to those somewhat acquainted already with the principles of physics. From the point of view of the beginner, however, difficulties might arise owing to the historical sequence necessitat-